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THE BIOLOGY OF THE MEXICAN FRUIT FLY

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Fruit flies have received this name because the larvae or maggots of these flies develop within the pulp of fruits causing them to become "wormy." The attack upon the fruit is made by the adult female fly which pricks the skin with a sharp blade-like ovipositor and in this way deposits her eggs in or beneath it. The very small larvae resulting when these eggs hatch burrow into the fruit and there grow, moving about and feeding as they increase in size. When they become mature they leave the fruit which by that time has usually fallen, crawl a short distance into the soil and there form a small brown case about the size and form of a grain of wheat, which is called the puparium. In due time, adult flies emerge from these puparia and work their way to the surface by means of a bladder on the front of the head which they can inflate. After emerging, the adults feed for a time, and then males and females mate and the female after another interval of time is ready to lay her eggs in other fruits, thus beginning another generation of flies.

The Mexican fruit fly, scientifically called Anastrepha ludens, occurs throughout southern and northeastern Mexico, and is repeatedly found in the citrus groves of the Rio Grande Valley in Texas. It is probably native to the area just south of the river.

It attacks a considerable variety of fruits--different varieties of citrus, mango, peach, pomegranate, white sapote, rose apple, mammea, annona, pear, and in the wild land of northeastern Mexico a small native fruit which belongs to the citrus family and which is called Sargentia greggii. The grapefruit and the mango are very heavily attacked.

The punctures through which the flies lay their eggs are too small to be noticed, and therefore a fruit may be wormy without any external sign. Usually, however, as the larvae grow, especially in citrus, the fruit takes on a deeper color and infested citrus can often be detected by its darker color. In grapefruit the larvae commonly work from the center of the fruit outward. Infested citrus drops earlier than that which is uninfested, although many infested fruit may still be found hanging upon the tree. Quite commonly the larvae when they become mature make a small round hole in the fruit called an "exit hole" or a "weep hole," the latter because of the fact that the juice drips out. These holes are commonly found at the blossom end of the fruit, but in well shaded places they may be found near the stem end or on the side. Sometimes larvae crawl out of these holes and drop to the ground while the fruit is still upon the tree. Any jarring of the fruit or rain beating upon it tends to cause the larvae to emerge and go into the ground.

The eggs are very small, elongate and white, just large enough to be seen with the unaided eye. They may be found in groups beneath the surface of the skin in otherwise sound fruits. It takes several days for them to hatch to young larvae. The length of time depends

upon the temperature. Under field temperatures varying from 67.3° F. to 75.2° F. this time has been found to range from 6 to 12 days, most of the eggs however hatching within a week.

The larvae hatched from the eggs are at first very small. As they feed they grow. This is accomplished by moulting. That is, a larva grows, casts its skin, then grows to cast another skin. This skin takes the place of a skeleton. Therefore there are three "stages" of larvae depending on their size. The fourth stage, as with all fruit flies, is found inside the puparium in the ground.

The larvae grow more rapidly in some fruits than in others even when the temperatures are the same. Thus with all kinds of fruit held at about 77° F. the egg and larval life was as short as 15 days in figs and as long as 52 days in mandarines. Also the length of life varies with the temperature. Even during June and July in Morelos, Mexico, it varied from 18.5 days to 35 days.

The puparia may remain in the soil also varying lengths of time before the adults emerge. This depends largely upon the temperature of the soil. Data show that this time increases in a regular manner from approximately 12 days at or near 88.5° F. to 107 days at or near 53.4° F. Therefore the approximate length of time can be determined from a record of the soil temperatures. Mortality of the puparia is rather high at both temperature extremes, but there is a normal emergence under constant temperatures ranging from 87° F. to 58° F. Soil temperatures do not fluctuate much even with rather wide fluctuations in air temperatures, therefore the puparia in the soil are not subject to the wide temperature variations experienced by the adults. Other factors

which influence the emergence from the puparia are moisture and the character of the soil. Mortality is high if moisture in the soil is lacking. But since puparia are formed in soil under trees, there is usually shade and sufficient moisture, especially under old trees headed low. Emergence is more easy in loose soil than in heavy soil, and emerged flies are able to reach the surface from considerable depths in loose soil. They are unable to travel upwards through 18 inches of thoroughly packed soil.

The adult flies which are full grown when they emerge from the puparia can withstand considerable cold. They have been observed actively feeding when the temperature was 59° F. to 60° F. In experiments flies have been subjected to temperatures below freezing on many occasions without undue mortality. One experimental population experienced a drop below freezing on twenty occasions and a minimum of 24.8° F. on eleven occasions, but after these experiences laid eggs and infested fruit heavily.

As a rule the flies seek shaded locations and avoid hot sun or flat open places. Therefore they may be expected more commonly in old groves and in trees where the aprons touch the ground. Infested fruit will be found in the interiors of such trees.

Sexual maturity does not take place immediately after emergence. The sexes may mate in about a week, or mating may be delayed for four or five weeks. After mating the females may begin to deposit eggs on the first day, or they may delay laying for a month or two. Different females may lay a larger or smaller number of eggs, and they may distribute them over different lengths of time, from a week to several months. A single female has been known to lay as high as 400 eggs.

The adult flies feed on sweet materials, fruit juices, exudates, etc. by sucking these up through the mouth parts like a house fly. They cannot chew foliage or pierce with the mouthparts. Very commonly they regurgitate droplets, then suck these up again. This habit of feeding permits the use of a poisoned sweetened spray for their control.

The flies are attracted for short distances to fermenting sweet materials as well as some other products. This has made possible the development and utilization of traps for containing such materials. Such traps do not catch enough flies to permit their utilization in control, but they are very valuable in determining the movement and density of fly populations, and the first appearance of flies in any locality. The adults move about over considerable distances. They often seek a location in large numbers for feeding purposes where there is no fruit in which they may lay eggs. They may be commonly found also where there are canals or water courses. On the other hand they have been trapped a considerable distance out into the scrub land of northeastern Mexico. South of the Rio Grande they show what appears to be a definite migration. They build up in citrus groves in the winter, first appearing in the fall. In the spring, they disappear from the groves and during summer build up in wild land where they reproduce a generation in the fruit of the native plant Sargentia. In the fall they appear once more in the groves and disappear from their summer territory. In Texas a somewhat similar situation prevails. They appear in the groves during winter, disappearing in the spring, and appear again the following fall or early winter.

The flies live a long time. With any population as with populations of other animals there is considerable death rate of very young individuals. Thereafter the death rate is low and some flies live more than a year, a few surviving to a year and a half.

A number of parasites attack the Mexican fruit fly. These are small wasps which lay their eggs in the larvae in the fruit. The parasites are unable to reach many of the larvae buried deep in the fruit and are not very effective in reducing populations which have attacked cultivated fruits such as citrus. With small fruits such as Sargentia they are somewhat more successful. Ants and other insects also destroy some larvae on the ground. The influence of all these natural enemies is not sufficient to prevent heavy fruit infestation.

The important points in the biology of the fly in attempts to fight it are the following:

(1) It is possible by means of traps to determine its presence by reason of its attraction to fermenting sweet solutions.

(2) It is possible by reason of its feeding habits to kill adults by means of poison spray before the females have had an opportunity to lay.

(3) It is possible knowing its habits to reduce emergence by destruction of all infested drops.

(4) Because the larvae can be killed by high and low temperatures it is possible to treat fruit so as to assure that it will not be dangerous to uninfested areas if shipped.